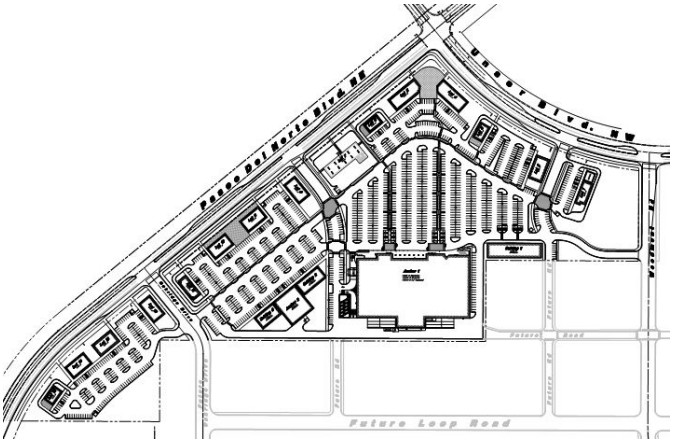
ANDERSON WAHLEN & ASSOCIATES

Volcano Heights Marketplace

Conceptual Drainage Report



Paseo Del Norte Blvd. NE
& Unser Blvd. NW
City of Albuquerque, New Mexico

TROY WOLVERTON
NEW MEXICO
PROFESSIONAL ENGINEER

June 14, 2017

Prepared For:

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Date: June 2017

Table of Contents

List of Appendices

1.0 INTRODUCTION AND STUDY PURPOSE

1.1 Project Overview

West Seventy, LLC is proposing to develop the 33-acre Volcano Heights Marketplace commercial site located in the City of Albuquerque, New Mexico (CABQ). The purpose of this report is to provide a summary of the conceptual onsite hydrologic analysis, while detailing how the proposed drainage infrastructure will convey and/or retain the required storm water discharges. This report will also examine the conceptual onsite and right-of-way improvements associated with the commercial development, and their relative impacts on required retention.

The City of Albuquerque Development Process Manual (DPM) was used to determine parameters and constraints necessary for calculating retention volume and for designing sufficient storm drain network conveyance.

The drainage improvements outlined in this report include:

- Onsite retention ponds sized for the 90th percentile storm event
- Privately maintained storm drain improvements on the Volcano Heights property for storm water conveyance to the onsite retention ponds
- Two temporary retention ponds located south and north of the Paseo Del Norte Blvd. and Unser Blvd. intersection
- Public storm drain within the Paseo Del Norte Blvd. and Unser Blvd. rights-of-way (with outfall at the temporary retention ponds)

1.2 Site Description

The Volcano Heights project is located within Township 11 North, Range 2 East, Section 15. A proposed commercial subdivision map will subdivide and delineate ownership of the site.

1.2.1 Site Location

The project site is located west of the Rio Grande River, west of the intersection of Paseo Del Norte Blvd NE and Unser Blvd NW. A project location map has been included in Appendix A for reference.

1.2.2 FEMA Flood Zone Designation

The Volcano Heights property is located on Flood Insurance Rate Map (FIRM) Panel 35001C0111G, revised September 26, 2008. The entirety of the site is classified as Flood Zone X (not shaded) and defined as, "Areas determined to be outside the 0.2% (500-Year) annual chance floodplain." An exhibit identifying the project location on the FIRM Panel has been included in Appendix A.

1.3 Existing Drainage Facilities

Several storm drain pipes exist within the public rights-of-way for Paseo Del Norte Blvd. and Unser Blvd. to carry storm water runoff across the streets, discharging in the open lands east and south of the property. In several locations, these storm drain pipes will be extended in order to convey the project's runoff to one of two temporary retention ponds. No regional detention exists near the project location, necessitating full retention of the property's storm water runoff until downstream regional detention facilities are in place.

2.0 HYDROLOGIC ANALYSIS

2.1 Design Storms

Per Chapter 22 of the DPM, the project site is located within Precipitation Zone 1 (defined as the area west of the Rio Grande). The principal design storm is the 100-year 6-hour event as defined by the NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States, Vol. IV – New Mexico. However, the DPM notes that storms of 24-hour duration or longer may be required for design of retention or detention ponds. For the Volcano Heights project, the CABQ has indicated that the temporary retention ponds located near the Paseo Del Norte Blvd and Unser Blvd intersection must be sized for the 100-year 10-day storm event.

2.2 Land Treatments

Chapter 22 of the DPM categorizes land cover and slopes by assigning areas to one of four land treatments (A through D). Land Treatment A areas generally exhibit little human disturbance and high infiltration rates, while Land Treatment D areas are fully improved (pavement, roofs, etc.).

For the Volcano Heights site, the onsite landscaping areas have been classified as Land Treatment B areas. Land Treatment B areas are defined as, "Irrigated lawns, parks and golf courses with 0 to 10 percent slopes. Native grasses, weeds and shrubs, and soil uncompacted by human activity with slopes greater than 10 percent and less than 20 percent." Land Treatment B areas comprise approximately 21.4% of the property. The remainder of the site has been classified as Land Treatment D, which is defined as, "Impervious areas, pavement and roofs."

3.0 90TH PERCENTILE ONSITE RETENTION PONDS

3.1 Introduction & Retained Volume Determination

Proposed site storm water improvements include onsite retention ponds for runoff volumes associated with the 90th percentile storm event. These facilities will retain the "first flush" and control runoff generated by contributing impervious surfaces. The "first flush" is defined by the CABQ as the storm water runoff during the early stages of a storm equal to or less than runoff from the 90th percentile

storm event. This runoff volume can deliver a potentially high concentration of pollutants due to the washing effect of runoff from impervious areas directly connected to the storm drainage system.

The relevant areas are as follows:

$$Property\ Area = 1{,}436{,}395\ ft^2\ or\ 32.975\ ac$$
$$Property\ Landscape\ Drainage\ Area\ (A_B) = 307{,}148\ ft^2\ or\ 7.051\ ac$$
$$Property\ Impervious\ Drainage\ Area\ (A_D) = 1{,}129{,}247\ ft^2\ or\ 25.924\ ac$$

$V_{90\%}$ is then calculated using the equation below:

$$90^{th}\ Percentile\ Storm\ Event\ Retention\ Volume\ (V_{90\%}) = \frac{0.34\ in.\ \times\ A_D}{12\ \frac{in}{ft}} = 31{,}995\ ft^3$$

The required 31,995 ft^3 of first flush retention volume has been spread throughout several onsite retention ponds (see Grading & Drainage Plan in Appendix A for pond locations). Any storm water runoff exceeding the first flush retention volume will enter the onsite storm drain network before being routed to the temporary retention ponds near the Paseo/Unser intersection.

3.2 Retention Pond Characteristics

The onsite 90th percentile storm retention ponds were designed to have approximately three feet (3') of water ponding at any time, with a minimum of one foot (1') of freeboard to the nearest site improvements. All ponds will be fully landscaped. Standpipes located at the highwater mark of each pond will convey storm water above the 90th percentile volume to the onsite storm drain network (and ultimately the temporary retention ponds sized for the 100-year event).

4.0 STORM DRAIN NETWORK

4.1 Onsite Storm Drain Layout

The project site generally slopes west to east, and storm drain inlets have been placed throughout the site to capture runoff associated with each development pad. The onsite storm drain pipes will be sized to convey the 100-year, 6-hour storm event in order to provide sufficient capacity to direct runoff to the temporary retention ponds (sized for the 100-year, 10-day storm event).

4.2 Public Right-of-Way Storm Drain Improvements

In order to convey the site flows to the temporary retention ponds, storm drain improvements will be constructed in Paseo Del Norte Blvd and Unser Blvd. Several storm drain laterals exist in both neighboring streets, serving to carry flows to the open lands east and south of the property. These laterals will be extended past the future 156' right-of-way lines to daylight into the temporary retention ponds.

A large storm drain line will be constructed in the Paseo right-of-way until reaching the low point in the street (just north of the intersection), at which point the existing storm drain lateral will pipe the flows east to the temporary retention pond.

A storm drain inlet will be constructed over the top of the northernmost storm drain lateral in Unser, and will capture runoff along Unser Blvd. south until reaching the high point in the road near the Woodmont Avenue intersection. The existing lateral at this location will be extended east into the temporary retention pond south of the Paseo/Unser intersection.

5.0 TEMPORARY RETENTION PONDS

5.1 Retained Volume Determination

Referencing Section 3.1 of this report for onsite impervious and landscape areas, the following values were used in calculating the required 100-year 10-day retention volume:

$$Total\ Drainage\ Area\ Including\ Streets\ (A_T) = 1{,}736{,}557\ ft^2\ or\ 39.866\ ac$$
$$Total\ Landscape\ Drainage\ Area\ (A_B) = 307{,}148\ ft^2\ or\ 7.051\ ac$$
$$Total\ Impervious\ Drainage\ Area\ (A_D) = 1{,}429{,}409\ ft^2\ or\ 32.815\ ac$$

Chapter 22 of the DPM was used to determine the following parameters for volumetric runoff calculations:

$$Landscape\ Excess\ Precipitation\ (E_B) = 0.67\ in.$$
$$Impervious\ Excess\ Precipitation\ (E_D) = 1.97\ in.$$
$$100\ Year\ 6\ Hour\ Impervious\ Precipitation\ Depth\ (P_{360}) = 2.20\ in.$$
$$100\ Year\ 10\ Day\ Impervious\ Precipitation\ Depth\ (P_{10DAYS}) = 3.67\ in.$$

Chapter 22 of the DPM also lists the following equations used to produce a total runoff volume for the 100-year, 10-day storm.

$$Weighted\ Excess\ Precipitation\ (E_W) = \frac{E_B A_B + E_D A_D}{A_T} = 1.74\ in.$$
$$6\ Hour\ Volume\ (V_{360}) = \frac{E_W (A_T)}{12\frac{in}{ft}} = 251{,}801\ ft^3\ or\ 5.78\ ac-ft$$
$$10\ Day\ Volume\ (V_{10DAYS}) = V_{360} + \frac{A_D (P_{10DAYS} - P_{360})}{12\frac{in}{ft}} = 426{,}903\ ft^3\ or\ 9.80\ ac-ft$$

The temporary retention ponds were therefore sized to retain just shy of 10 acre-feet of runoff volume.

5.2 Retention Pond Characteristics

The large area required to detain almost 10 acre-feet of storm water runoff, as well as the low spot in Paseo Del Norte Blvd (too low in elevation to daylight in a pond across Unser) necessitated two temporary retention ponds to split the storage required for the 100-year 10-day storm event. The first pond, located north of the Paseo/Unser intersection, will retain approximately 4 acre-feet, with the second pond, located south of the Paseo/Unser intersection, retaining the remaining 6-acre-feet. These pond areas will not be improved, and dirt berms will be constructed around the ponds to retain water on the existing ground surface.

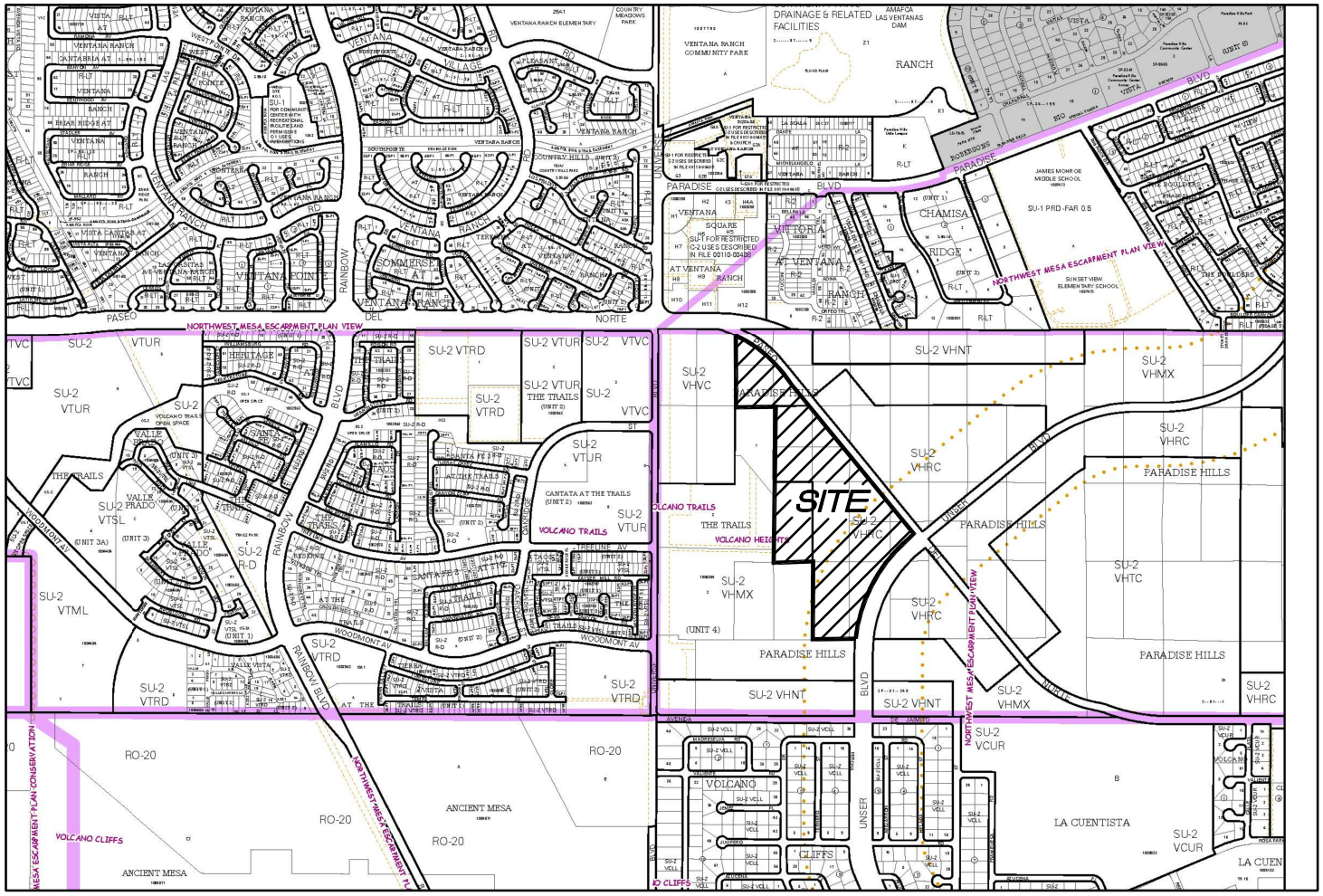
Based on topographical surveys conducted around the Paseo/Unser intersection, the dirt berms were placed in order to retain the necessary volume while providing an average pond depth of two feet.

6.0 CONCLUSION

This report has been prepared in accordance with the requirements and specifications of Chapter 22 of the DPM. All storm water runoff generated on the site will be conveyed via the onsite storm drain network to one of six retention ponds designed to retain the 90th percentile storm event. Runoff in excess of the 90th percentile storm event will be piped to one of two temporary retention ponds located near the Paseo/Unser intersection. These temporary retention ponds will remain in place until downstream regional detention facilities are constructed.

APPENDIX A

SITE EXHIBITS



Vicinity Map

Zone Atlas Page: C-10-Z
Not to Scale

MAP SCALE 1" = 500'

50 0 500 1000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0111G

FIRM

FLOOD INSURANCE RATE MAP

BERNALILLO COUNTY, NEW MEXICO AND INCORPORATED AREAS

PANEL 111 OF 825

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

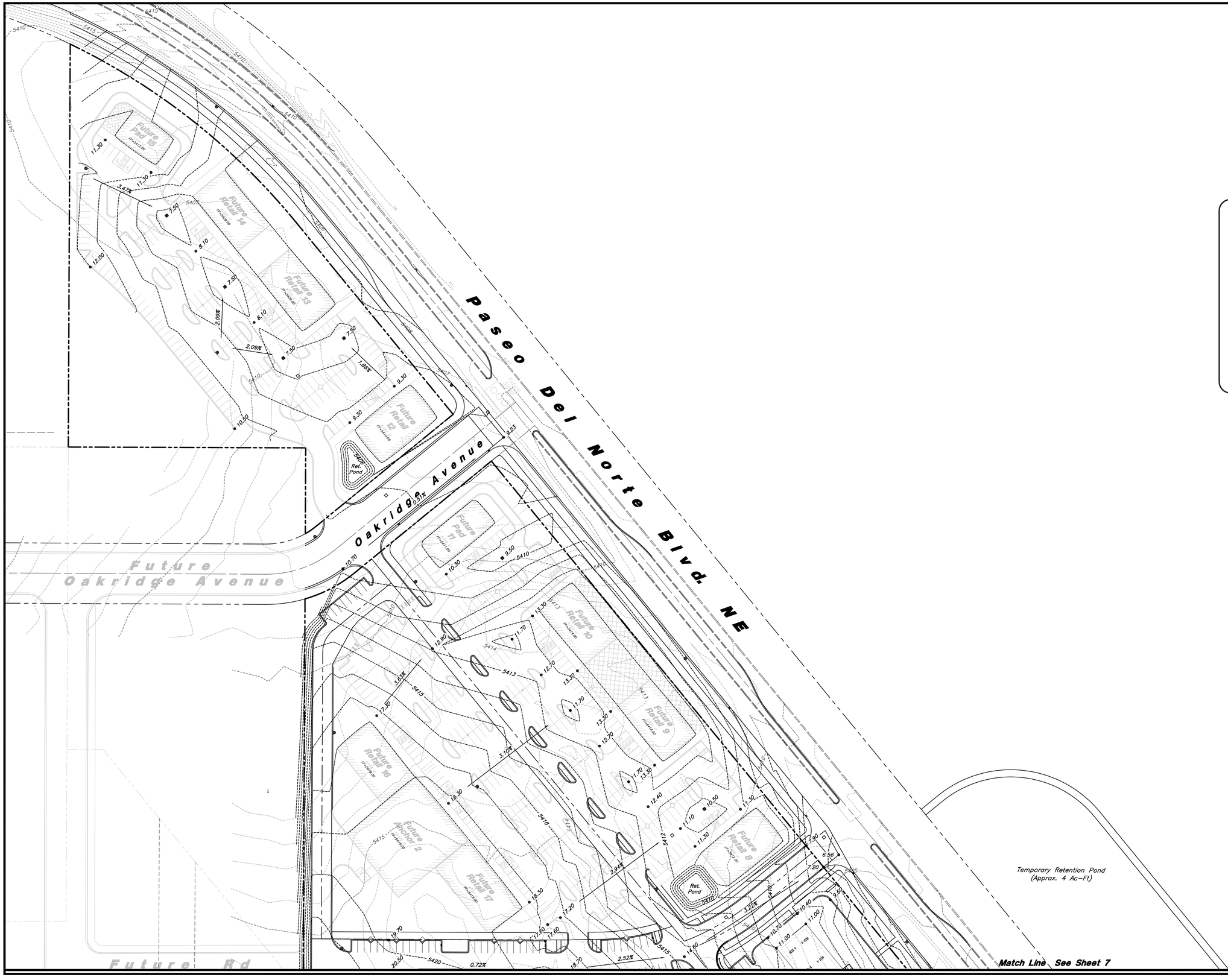
COMMUNITY	NUMBER	PANEL	SUFFIX
ALBUQUERQUE, CITY OF	350002	0111	G
BERNALILLO COUNTY UNINCORPORATED AREAS	350001	0111	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
35001C0111G

MAP REVISED
SEPTEMBER 26, 2008

Federal Emergency Management Agency



Scale: 1" = 60'

60' 0 60' 120'

Legend

- Proposed Inlet Box
- Proposed Catch Basin
- Proposed Manhole
- Proposed Water Meter
- Proposed Fire Hydrant
- Proposed Water Line — W —
- Proposed Sanitary Sewer — SAS —
- Proposed Storm Drain — SD —
- Proposed Power Line — P —
- Proposed Contour --78--
- Direction of Drainage
- Proposed Spot • 78.00
- Property Line
- Proposed Light Pole
- Proposed Building
- Existing Improvements
- Existing Inlet Box
- Existing Manhole
- Existing Fire Hydrant FH
- Existing Water — W —
- Existing Storm Drain — SD —
- Existing Contour 78

REV	DATE	DESCRIPTION

Designed by: KR
Drafted by: JC
Client Name:
West Seventy, LLC

SMC469GR

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Grading & Drainage Plan

Volcano Heights Marketplace

Unser Blvd. NW & Paseo Del Norte Blvd. NE
Albuquerque, New Mexico

TROY WOLVERTON NEW MEXICO 23994 PROFESSIONAL ENGINEER

14 Jun, 2017

SHEET NO.
6

Match Line See Sheet 6

Scale: 1" = 60'

60' 0 60' 120'

Anchor 1
119,969 sf (Footprint)
123,694 sf (w/ Mezzanine)
FF=5422.00

Pad 7
FF=5416.50

Pad 6
FF=5408.50

Pad 3
FF=5398.50

Retail 5
FF=5408.50

Retail 4
FF=5408.50

Retail 2
FF=5411.00

Future Retail 18
FF=5417.83

Future Pad 1
FF=5411.00

Ret. Pond

Retention Pond

Temporary Retention Pond (Approx. 4 Ac-Ft)

Temporary Retention Pond (Approx. 6 Ac-Ft)

Paseo Del Norte Blvd. NE

Unser Blvd. NW

Basalt Drive

Future Road

Woodmont Avenue NW

Legend

- Proposed Inlet Box
- Proposed Catch Basin
- Proposed Manhole
- Proposed Water Meter
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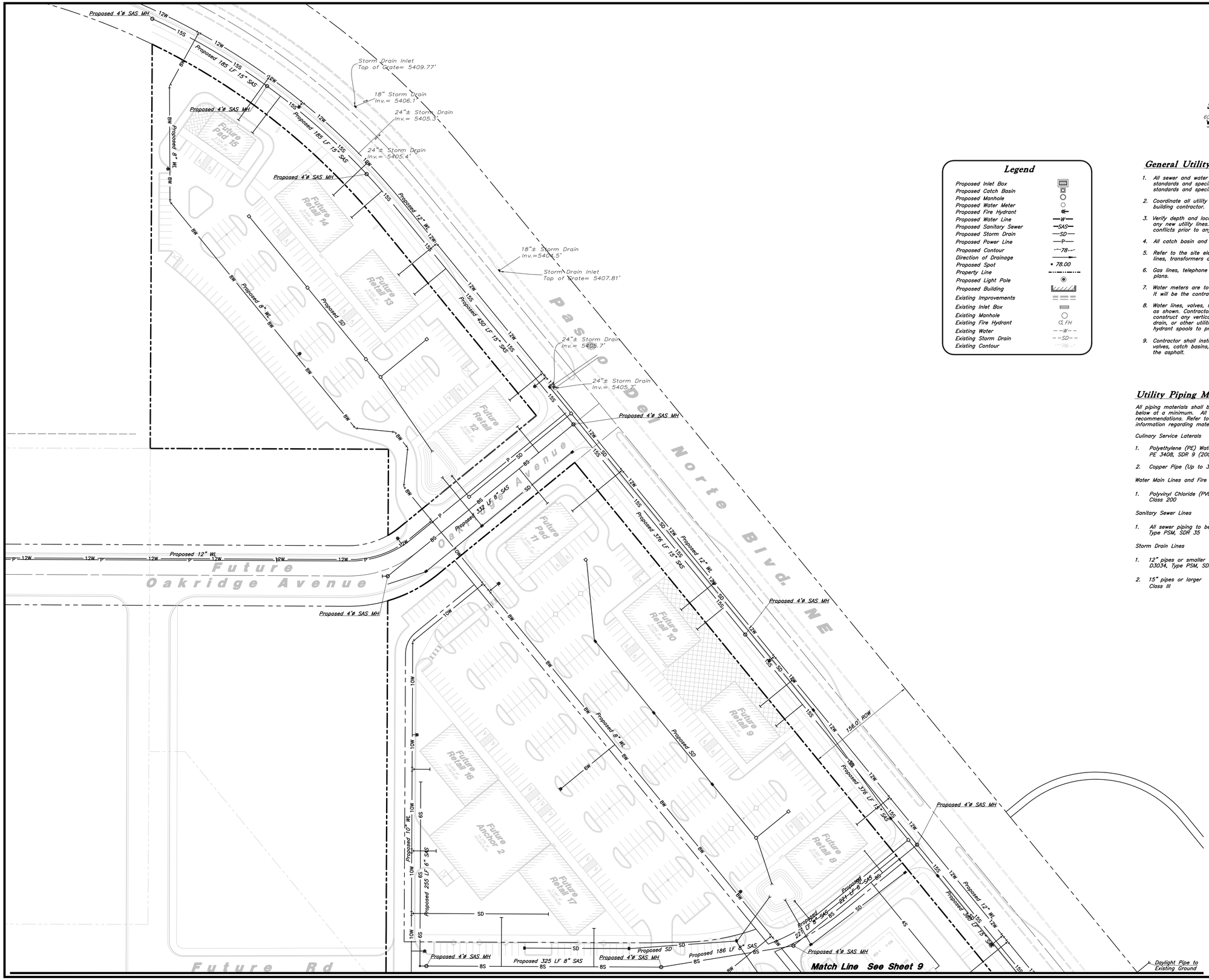
SHEET NO.
7



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- Existing Fire Hydrant FH
- Existing Water — W —
- Existing Storm Drain — SD —
- Existing Contour — 78 —

General Utility Notes:

1. All sewer and water facilities shall be constructed per local jurisdiction standards and specifications. Contractor is responsible to obtain standards and specifications.
2. Coordinate all utility connections to building with plumbing plans and building contractor.
3. Verify depth and location of all existing utilities prior to constructing any new utility lines. Notify Civil Engineer of any discrepancies or conflicts prior to any connections being made.
4. All catch basin and inlet box grates are to be bicycle proof.
5. Refer to the site electrical plan for details and locations of electrical lines, transformers and light poles.
6. Gas lines, telephone lines, and cable TV lines are not a part of these plans.
7. Water meters are to be installed per city standards and specifications. It will be the contractor's responsibility to install all items required.
8. Water lines, valves, fire hydrants, fittings etc. are to be constructed as shown. Contractor is responsible, at no cost to the owner, to construct any vertical adjustments necessary to clear sewer, storm drain, or other utilities as necessary including valve boxes and hydrant spools to proper grade.
9. Contractor shall install a 12" concrete collar around all manholes, valves, catch basins, cleanouts & any other structures located within the asphalt.

Utility Piping Materials:

All piping materials shall be per local agency standards or the specifications below at a minimum. All utility piping shall be installed per manufacturers recommendations. Refer to project specifications for more detailed information regarding materials, installation, etc.

Culinary Service Laterals

1. Polyethylene (PE) Water Pipe (Up to 3 inches diameter), AWWA C901, PE 3408, SDR 9 (200 psi)
2. Copper Pipe (Up to 3 inches diameter): Type 'K.'

Water Main Lines and Fire Lines

1. Polyvinyl Chloride (PVC) (4 inches to 12 inches diameter): AWWA C900, Class 200

Sanitary Sewer Lines

1. All sewer piping to be Polyvinyl Chloride (PVC) sewer pipe, ASTM D3034, Type PSM, SDR 35

Storm Drain Lines

1. 12" pipes or smaller – Polyvinyl Chloride (PVC) sewer pipe, ASTM D3034, Type PSM, SDR 35
2. 15" pipes or larger – Reinforced Concrete Pipe, ASTM C76, Class III

CAUTION :

The locations and/or elevations of existing utilities as shown on these plans are based on records of the various utility companies and, where possible, measurements taken in the field. The information is not to be relied on as being exact or complete.

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Drafted by: JC
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Utilities Overall Site Plan 1

Volcano Heights Marketplace
Unser Blvd. NW & Paseo Del Norte Blvd. NE
Albuquerque, New Mexico

TROY WOLVERTON NEW MEXICO 23994 PROFESSIONAL ENGINEER

14 Jun, 2017

SHEET NO.
8

Match Line See Sheet 8

Scale: 1" = 60'

60' 0 60' 120'

General Utility Notes:

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2. Copper Pipe (Up to 3 inches diameter): Type "K."

Water Main Lines and Fire Lines

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Sanitary Sewer Lines

1. All sewer piping to be Polyvinyl Chloride (PVC) sewer pipe, ASTM D3034, Type PSM, SDR 35

Storm Drain Lines

1. 12" pipes or smaller – Polyvinyl Chloride (PVC) sewer pipe, ASTM D3034, Type PSM, SDR 35
2. 15" pipes or larger – Reinforced Concrete Pipe, ASTM C76, Class III

Legend

Proposed Inlet Box	
Proposed Catch Basin	
Proposed Manhole	
Proposed Water Meter	
Proposed Fire Hydrant	
Proposed Water Line	—W—
Proposed Sanitary Sewer	—SAS—
Proposed Storm Drain	—SD—
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Volcano Heights Marketplace

Unser Blvd. NW & Paseo Del Norte Blvd. NE
Albuquerque, New Mexico

Utility Plan

TROY WOLVERTON NEW MEXICO 23994 PROFESSIONAL ENGINEER

14 Jun, 2017

SHEET NO. 9

APPENDIX B

CHAPTER 22 DPM EXCERPTS

PART A - PROCEDURE FOR 40 ACRE AND SMALLER BASINS

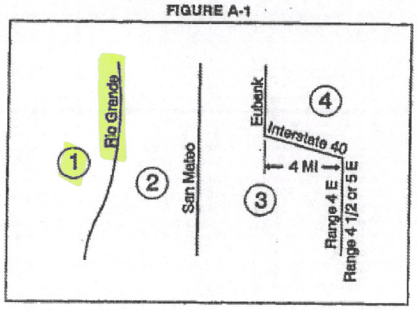
A simplified procedure for projects with sub-basins smaller than 40 acres has been developed based on initial abstraction/uniform infiltration precipitation losses and Rational Method procedures. For this procedure, Bernalillo County has been divided into four (4) Precipitation Zones.

A.1 PRECIPITATION ZONES

Bernalillo County's four precipitation zones are indicated in TABLE A-1 and on FIGURE A-1.

TABLE A-1. PRECIPITATION ZONES	
Zone	**Location**
1	West of the Rio Grande
2	Between the Rio Grande and San Mateo
3	Between San Mateo and Eubank, North of Interstate 40; and between San Mateo and the East boundary of Range 4 East, South of Interstate 40
4	East of Eubank, North of Interstate 40; and East of the East boundary of Range 4 East, South of Interstate 40

FIGURE A-1



Where a watershed extends across a zone boundary, use the zone which contains the largest portion of the watershed.

A.2 DESIGN STORM

The principal design storm is the 100-year 6-hour event defined by the NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States, Vol. IV - New Mexico. Assume an AMC II condition (a normally dry watershed). For design of retention or detention ponds, storms of 24-hour or longer duration many be required. The 24-hour event is defined by the NOAA Atlas 2. The 4-day and 10-day events can be obtained using the procedures in S.C.S. TSC Technical Note-Hydrology, PO-6 (Rev. 2) The 100-year 60-minute depth is computed by the following formula from Table 11 of NOAA Atlas 2:

$$P_{60} = 0.494 + 0.755 * (P_{360} * P_{360} / P_{1440}) \qquad (a\text{-}1)$$

TABLE A-2. DEPTH (INCHES) AT 100-YEAR STORM					
Zone	P_{60}	P_{360}	P_{1440}	P_{4days}	P_{10days}
1	1.87	2.20	2.66	3.12	3.67
2	2.01	2.35	2.75	3.30	3.95
3	2.14	2.60	3.10	3.95	4.90
4	2.23	2.90	3.65	4.70	5.95

The 2-year 60-minute depth is computed by the following formula from NOAA Atlas 2:

$$P_{60\text{-}2} = -0.011 + 0.942 * (P_{360\text{-}2} * P_{360\text{-}2} / P_{1440\text{-}2}) \qquad (a\text{-}2)$$

Based on fitting a logarithmic curve to the values in Table 12 of NOAA Atlas 2, the 12- minute (0.2 hour) depth was computed to be 50.24 percent of the 60-minute depth:

$$P_{12} = 0.5024 * P_{60} \qquad (a\text{-}3)$$

For certain applications (e.g., street drainage, low flow channels and sediment transport) storms of greater frequency than the 100-year storm must be considered. To estimate precipitation at return periods other than 100 years, multiply the 360-minute or 1440-minute 100-year precipitation amounts by the factors in TABLE A-3.

TABLE A-4. LAND TREATMENTS	
Treatment	**Land Condition**
A	Soil uncompacted by human activity with 0 to 10 percent slopes. Native grasses, weeds and shrubs in typical densities with minimal disturbance to grading, ground cover and infiltration capacity.
B	Irrigated lawns, parks and golf courses with 0 to 10 percent slopes. Native grasses, weeds and shrubs, and soil uncompacted by human activity with slopes greater than 10 percent and less than 20 percent.
C	Soil compacted by human activity. Minimal vegetation. Unpaved parking, roads, trails. Most vacant lots. Gravel or rock on plastic (desert landscaping). Irrigated lawns and parks with slopes greater than 10 percent. Native grasses, weeds and shrubs, and soil uncompacted by human activity with slopes at 20 percent or greater. Native grass, weed and shrub areas with clay or clay loam soils and other soils of very low permeability as classified by SCS Hydrologic Soil Group D.
D	Impervious areas, pavement and roofs.
Most watersheds contain a mix of land treatments. To determine proportional treatments, measure respective subareas. In lieu of specific measurement for treatment D, the areal percentages in TABLE A-5 may be employed.	

TABLE A-5. PERCENT TREATMENT D (Impervious)	
Land Use	**Percent**
Commercial*	90
Single Family Residential N=units/acre, N6	7*Sq.Rt.((N*N)+(5*N)) (a-4)
Multiple Unit Residential Detached* Attached*	 60 70
Industrial Light* Heavy*	 70 80
Parks, Cemeteries	7
Playgrounds	13
Schools	50
Collector & Arterial Streets	90
*Includes local streets	

TABLE A-5 does not provide areal percentages for land treatments A, B and C. Use of TABLE A-5 will require additional analysis to determine the appropriate areal percentages of these land treatments.

Backyard retention ponds, and other small on-site ponding, may have the effect of reducing runoff from impervious areas. Where it can be clearly demonstrated that backyard and small on-site retention ponding currently exist, impervious and/or pervious areas which drain to such ponds can be given credit towards their determination of peak rates of runoff and runoff volumes from the development.

A.4 ABSTRACTIONS

Initial abstraction is the precipitation depth which must be exceeded before direct runoff begins. Initial abstraction may be intercepted by vegetation, retained in surface depressions, or absorbed on the watershed surface. Initial abstractions are shown in TABLE A-6.

TABLE A-6. INITIAL ABSTRACTION (IA)	
Treatment	**Initial Abstraction (inches)**
A	0.65
B	0.50
C	0.35
D	0.10

Infiltration is the only significant abstraction after the initial abstraction. After initialabstraction is satisfied, treat infiltration as a constant loss rate as specified in TABLE A-7.

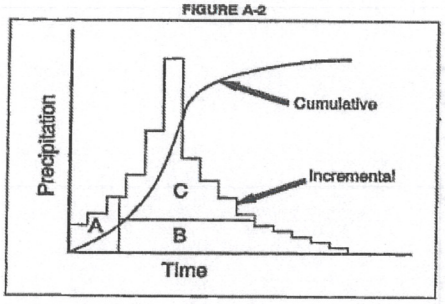
TABLE A-7. INFILTRATION (INF)	
Treatment	**Loss Rate (inches/hour)**
A	1.67
B	1.25
C	0.83
D	0.04*
* Treatment D infiltration rate is applicable from 0 to 3 hours; use uniform reduction from 3 to 6 hours, with no infiltration after 6 hours.	

Runoff from a previous event can saturate a channel bed, rendering it minimally pervious for several days. Do not anticipate additional bed losses for design purposes.

A.5 EXCESS PRECIPITATION & VOLUMETRIC RUNOFF

Excess precipitation, E, is the depth of precipitation remaining after abstractions are removed. Excess precipitation does not depend on watershed area. Excess precipitation is determined by subtracting the initial abstraction and infiltration from the design storm hydro graph. FIGURE A-2 illustrates the development of excess precipitation. The curved line plots cumulative precipitation. Precipitation intensities (in/hr) are shown as a histogram. Initial abstraction is area A. The horizontal line is at a height corresponding to the infiltration rate. Infiltration loss is area B. The remaining histogram, area C, is excess precipitation.

FIGURE A-2



Excess precipitation, E, by zone and treatment is summarized in TABLE A-8.

*(**NOTE:** In this table and several tables which follow, corresponding values for 2- and 10- year storms are shown in brackets below each 100-year value)*

TABLE A-8. EXCESS PRECIPITATION, E (INCHES) - 6 HOUR STORM

Zone	100-YR.. Treatment [2-YR., 10-YR.]			
	A	B	C	D
1	0.44 [0.00, 0.08]	0.67 [0.01, 0.22]	0.99 [0.12, 0.44]	1.97 [0.72, 1.24]
2	0.53 [0.00, 0.13]	0.78 [0.02, 0.28]	1.13 [0.15, 0.52]	2.12 [0.79, 1.34]
3	0.66 [0.00, 0.19]	0.92 [0.06, 0.36]	1.29 [0.20, 0.62]	2.36 [0.89, 1.50]
4	0.80 [0.02, 0.28]	1.08 [0.11, 0.46]	1.46 [0.27, 0.73]	2.64 [1.01, 1.69]

To determine the volume of runoff,

1) Determine the area in each treatment, A_A, A_B, A_C, A_D

2) Compute the weighted excess precipitation, E

$$\text{Weighted } E = \frac{E_A A_A + E_B A_B + E_C A_C + E_D A_D}{A_A + A_B + A_C + A_D} \quad \text{(a-5)}$$

3) Multiply the weighted E by the watershed area.

V_{360} (as volume) = weighted E* $(A_A + A_B + A_C + A_D)$ (a-6)

EXAMPLE A-3

Find the 100-year V_{360} for 30 acres in zone 1. Eight acres are treatment A, 10 acres are treatment B, 5 acres are treatment C, and 7 acres are treatment D.
Weighted E = ((8 * 0.44) + (10 * 0.67) + (5 * 0.99) + (7 * 1.97)) / 30 = 0.965 inches
Volume = (0.965 * 30) / 12 = 2.41 acre-ft. = V_{360}

For ponds which hold water for longer than 6 hours, longer duration storms are required to establish runoff volumes. Since the additional precipitation is assumed to occur over a long period, the additional volume is based on the runoff from the impervious areas only.

For 24-hour storms:

$V_{1440} = V_{360} + A_D * (P_{1440} - P_{360}) / 12$ in/ft (a-7)

For 4-day storms:

$V_{4DAYS} = V_{360} + A_D * (P_{4DAYS} - P_{360}) / 12$ in/ft (a-8)

For 10-day storms:

$V_{10DAYS} = V_{360} + A_D * (P_{10DAYS} - P_{360}) / 12$ in/ft (a-9)